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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid fuel cell to which direct oxidation of the liquid fuel is carried out indirectly or preferably with an anode. Especially this invention holds the liquid fuel to the anode of a liquid fuel cell, and relates to the reservoir for measuring-supplying or sending the liquid. This invention relates also to the liquid fuels supply system for micro fuel cell reformers again.

[0002]

[Description of the Prior Art] This application asserts U.S. patent application 09th / privilege of No. 894,939 for which it applied on June 28, 2001, and incorporates the indication by reference.

[0003] An electrochemistry fuel cell changes a reactant, i.e., fuel, and an oxidizer, and produces electric power and a resultant. Generally an electrochemistry fuel cell uses the electrolyte arranged between two electrodes (an anode and a cathode). It is needed in order that the electrocatalysis may trigger the electrochemical reaction of a wish by an electrode. The fluid supply solid polymer fuel cell operates in the boiling point of fuel, i.e., methanol, from about 0 ** in about 65 ** temperature requirement, and is preferred at especially the application to a mobile. In a solid polymer fuel cell, it is a membrane electrode assembly (). [membrane electrode assembly and] "MEA" is contained and this is provided with the solid polymer electrolyte (proton-exchange membrane), i.e., the cation exchange membrane sometimes written as "PEM", which are arranged between two electrode layers. The flow field (flow field) plate to which a reactant is led so that the 1 surface of each electrode may be crossed is usually arranged at the each side of a membrane electrode assembly.

[0004] In a solid polymer fuel cell, it is assumed that an extensive reactant is used and such a reactant is introduced as gas or a fluid. Although pure oxygen gas may be substantially

sufficient as the flow of an oxidizer, dilution oxygen like air is used preferably. Pure hydrogen gas may be substantially sufficient as fuel, or a liquid-organic-fuel mixture may be sufficient as it. Here, liquid fuel flows out, it is a fuel cell which operates and that (direct oxidation is carried out) to which fuel reacts electrochemically with an anode is known as a direct type fluid supply fuel cell.

[0005]A direct type methanol fuel cell (direct methanol fuel cell, "DMFC") is one type of a direct type fluid supply fuel cell, direct oxidation of the fuel (liquid methanol) is carried out with an anode, and the following reactions occur.

[0006]anode: $-- \text{CH}_3\text{OH} + \text{H}_2\text{O} \rightarrow 6\text{H}^+ + \text{CO}_2 + 6\text{e}^-$ cathode: $-- 1.5\text{O}_2 + 6\text{H}^+ + 6\text{e}^- \rightarrow 3\text{H}_2\text{O}$ [0007]A film is penetrated, it combines with oxygen and an electron by the cathode side, and a hydrogen ion (H^+) generates water. The electron (e^-) cannot penetrate a film but flows into a cathode from an anode through the external circuit which makes the electric load which consumes the electric power which was generated by the cell for this reason drive. The resultants in an anode and a cathode are carbon dioxide (CO_2) and water (H_2O), respectively. The open-circuit voltage of a single cell is about 0.7 volt. In order to obtain bigger voltage, some direct type methanol fuel cells are accumulated in series.

[0008]Other liquid fuel other than methanol, i.e., other easy alcohol, for example, ethanol, dimethoxymethane, trimethoxy methane, and formic acid can also be used for a direct type liquid fuel cell. As an oxidizer, it can make available in the form of an organic fluid with a high oxygen density, i.e., a hydrogen peroxide solution.

[0009]Although a direct type methanol fuel cell can be operated with aqueous methanol vapour, a dilution methanol aqueous fuel solution is most ordinarily supplied with a fluid. In order to prevent what fuel contacts a cathode directly and oxidizes there (called "crossing over"), it is important to maintain separation between an anode and a cathode. Since the electron obtained by oxidation reaction does not follow the current route between electrodes, a crossover becomes a short circuit in a cell as a result. In order to reduce a possibility that methanol fuel crosses the cathode side from an anode through MEA, the very thin solution (for example, about 5% of methanol aqueous solution) of methanol is usually used as a flow of fluid supply DMFC fuel.

[0010]Polymer electrolyte membrane (PEM) is a solid organic high polymer and common polyperfluoro sulfonic acid, and this constitutes the inside core of a membrane electrode assembly (MEA). The polyperfluoro sulfonic acid for PEM is marketed with the trademark of E.I. DuPont de Nemours & Company to NAFION (registered trademark). PEM must be hydrated in order to function appropriately as an electrolyte as proton (hydrogen ion) exchange membrane again. In order that a fuel cell may function efficiently, by a controllable method, it must be measuring-supplied or liquid fuel must be sent at the anode side. Especially with the

fuel cell planned as this problem being used with the application, for example, the household appliance, and the cellular phone to a mobile, it is serious and the direction of a fuel cell to gravity will change in these. Liquid sending of fuel will stop at the conventional fuel tank for which an exit is located at the bottom of a reservoir and it depends on supply by prudence, if direction of a tank changes.

[0011]Liquid sending by the immersion tube of the liquid fuel in a reservoir changes with the quantity of the fuel which remains in direction of the tube in a reservoir, and a reservoir. If drawing 1 is referred to, the cartridge 10 will have accommodated the liquid fuel mixture 12 into it. The outlet tubes 14 and the air inlet tube 16 have projected from the cartridge cover 18. If the cartridge 10 is fixed to this direction, the fuel mixture will be able to be pulled out from the outlet tubes 14 by the pump action, and the capacity space occupied with the fuel which leaves the cartridge 10 will be filled with the air which enters through the air inlet tube 16.

[0012]However, if the cartridge 10 is leaned just beside, only when a fuel level exceeds the fuel migration points of outlet tubes, it will be thought that a fuel mixture cannot be pulled out.

[0013]

[Problem(s) to be Solved by the Invention]Therefore, in order to be able to use a liquid fuel cell easily by mobile apparatus, it is not based on direction but a liquid fuel reservoir which stores fuel by a controllable method and sends it to a liquid fuel cell is desired. It is exchangeable, and it can throw away and a liquid fuel reservoir possible [replacement] or recyclable is still more desirable. It is also desirable to maximize the quantity of the liquid fuel which a liquid fuel reservoir can accommodate.

[0014]

[Means for Solving the Problem]A fuel reservoir for liquid fuel cells of this invention (fuel reservoir), (a) A container (container) which has a wall and an inside which demarcate a cavity for holding liquid fuel for liquid fuel cells, (b) It is arranged in a cavity, and at least some liquid fuel is sucked up and it has from there an exit passage which connects liquid fuel with a wicking structure which can discharge [which can discharge and can measuring-supply] or can send the liquid, and a wicking structure in the (c) cavity and which pierces through a container there.

[0015]A fuel reservoir of this invention holds liquid fuel for liquid fuel cells by a controllable method. In this fuel reservoir, since liquid fuel in a container is not based on direction of a fuel reservoir but is carrying out the fluid free passage with an exit passage, it cannot be based on direction but fuel can be sent to a liquid fuel cell. The liquid fuel stored in a fuel reservoir can leave a container, without being dependent on gravity.

[0016]Attachment to a fuel cell and removal are selectively possible for a fuel reservoir of this invention. Therefore, exchangeable and throwing away are possible for this fuel reservoir, or it can be replaced. A fuel reservoir in that a spent fuel reservoir can be preferably re-filled up into

fuel with liquid fuel again through an exit passage or a liquid fuel entrance of option which has the film which is made of a valve or tolerant rubber, Recycling is possible, or re-restoration can also be possible, since it is re-filled up with a fuel reservoir through this film, liquid fuel can be introduced into a spent fuel reservoir by hypodermic needle or a prototype, and a film carries out the seal of the cavity again after fuel introduction. In one embodiment of a fuel reservoir in which re-restoration is [that recycling of this invention is possible, or] possible, in an exit passage. While being kept or conveyed before making it possible to introduce liquid fuel into a spent fuel reservoir and being used for the next, a valve or a seal cap which prevents liquid fuel leaking from a fuel reservoir with which it re-filled up is equipped. In another embodiment of a fuel reservoir in which re-restoration is [that recycling is possible or] possible, a fuel reservoir, It makes it possible to introduce liquid fuel into a spent fuel reservoir, and has further a liquid fuel entrance where a valve or a seal cap which prevents liquid fuel leaking from a fuel reservoir with which it re-filled up was equipped.

[0017]A wicking structure makes it possible to measuring-supply or to send wicking of a fluid, and not only maintenance but liquid fuel by a controllable method. A wicking structure is shape which has the longest size. In a cylindrical wicking structure, the longest size becomes either the height or its diameter with a cylindrical relative size. In a rectangular cube type wicking structure, the longest size becomes either the height, its depth or width with a relative size of a box. The longest size can become the same in two or more directions at other shape, for example, a square core box reservoir. Free rise Wick height (measure of capillary action) of a wicking structure is [of the longest size] larger at least than $1/2$ preferably, and free rise Wick height will be larger than the longest size most preferably.

[0018]A wicking structure can be built with foam, a fiber bundle, a textiles mat, textile, non-woven textile, or a charge of an inorganic porous material. A wicking structure may be a porous member which generally consists of one sort or two or more polymers which have tolerance in liquid fuel. Preferably, a wicking structure is polyurethane foam (preferably). Felt-like polyurethane foam, mesh shape polyurethane foam, or felt-like mesh shape polyurethane foam, It is built with wicking material chosen from nonwoven felt or a bunch of polyester, such as polyamide, such as melamine foam and nylon, polypropylene, and polyethylene terephthalate, cellulose, polyethylene, polyacrylonitrile, and these mixtures. A wicking structure as an exception method preferably, polyurethane foam (desirable -- felt-like polyurethane foam.) Mesh shape polyurethane foam or felt-like mesh shape polyurethane foam, Polyamide, such as melamine foam and nylon, polyethylene, polypropylene, Polyester, polyacrylonitrile, or nonwoven felt of these mixtures, It is built with polyester, such as cellulose and polyethylene terephthalate, polyethylene, polypropylene, polyacrylonitrile and a fiber bundle that consists of these mixtures, a textiles mat, or wicking material chosen from textile. An inorganic powder sintered compact which consists of a certain specific charge of an inorganic porous material,

for example, silica, and alumina can also be used as a wicking material of a wicking structure. [0019]a case where polyurethane foam is chosen as a wicking structure -- density of this foam -- about 0.5 to about 45 -- it being in the range of about 0.5 to about 25 pounds per cubic foot preferably, and, The pore size should be in the range of about 10 to about 200 pores / inch, Density of pore size is the range of about 40 to about 200 pores / inch more preferably in the range of about 0.5 to about 15 pounds per cubic foot, and density of pore size is the range of 75 to 200 pores / inch in the range of 0.5 to ten pounds per cubic foot most preferably.

[0020]When felt-like polyurethane foam, such as felt-like mesh shape polyurethane foam, is chosen as a wicking structure, Density of this felt-like foam is in the range of about two to about 45 pounds per cubic foot, The compression ratio should be in about 1.1 to about 30 range, range of a compression ratio of density is about 1.1 to about 20 preferably in the range of about three to about 15 pounds per cubic foot, and range of a compression ratio of density is 2.0 to 15 in the range of 3 to 10 pounds / cube Fet most preferably.

[0021]Felt-like foam applies sufficient heat and a pressure to compress foam into what [1/] of thickness of origin of it, and is manufactured. Foam is compressed into 1/30 of thickness of origin of it with the compression ratio 30. Foam is compressed into one half of thickness of origin of it with the compression ratio 2.

[0022]Mesh shape foam removes a cell film (cell window) from porosity polymer structure, it is manufactured by leaving a network of a skeleton (strand), and fluid transmissivity of mesh shape foam which was obtained for this reason increases. Foam can be made into mesh shape by a chemical or thermal in situ method as all are known by foam production technology person.

[0023]permanent in wicking material, when fabricating wicking structure -- or lossless compression can be carried out. An example of wicking material by which permanent compression was carried out is felt-like wicking material. An example of a wicking structure by which lossless compression was carried out is a wicking structure formed by compressing wicking material while being put into wicking material by cavity of a container, While wicking material is in an inside of a container, structures, such as a wall of a container, help to maintain at the state where wicking material was compressed.

[0024]Especially, in a desirable embodiment, a wicking structure is built with foam with inclination of capillary action, and a flow of liquid fuel is oriented with another portion of a structure from a part of structure as a result of a difference of capillary action between two portions. One method of manufacturing foam with inclination of capillary action is felting foam as a degree's of compaction is changing along with the longitudinal direction. A flow by capillary action of a fluid goes to a compressive large portion from a portion with little compression. A wicking structure can be built with a complex of a separate ingredient which consists of foam or other materials in which capillary action differs clearly as an exception

method. Probably capillary action of inclination of capillary action is the maximum in a wicking structure portion very near the exit passage of a fuel reservoir, and capillary action will be so smaller that a wicking structure portion becomes distance from an exit passage. With inclination of such capillary action, liquid fuel in a wicking structure is oriented so that it may flow toward an exit passage from a point which is most distantly distant from an exit passage, and it helps liquid sending of liquid fuel by a fuel reservoir.

[0025]In one embodiment, as for a wicking structure held in a container, shape becomes the same as a container cavity substantially.

[0026]In order to make into the maximum quantity of liquid fuel accommodated in a container, it is desirable by making solid capacity of a wicking structure into the minimum to make into the minimum capacity actually occupied by wicking structure in a container. Or in order to make into the maximum quantity of liquid fuel accommodated in a container, it is desirable to make wicking material capacity into the minimum.

[0027]"Solid capacity (solid volume)" of a wicking structure is capacity occupied with a solid material of a wicking structure. In another way of speaking, "solid capacity" lengthens the hole (void) capacity from outside capacity (external volume) of a wicking structure.

[0028]"Wicking material capacity" or "capacity of a wicking structure" is the sum of solid capacity and capacity of wicking pore in wicking material.

[0029]capacity of a cavity in a container of wicking material capacity is about 50% or less preferably -- more -- desirable -- about 25 or less -- and it is about 10% or less most preferably. hole volume of wicking material -- wicking material outside capacity -- desirable -- at least about 50% -- more -- desirable -- about 65% to 98% -- and it is about 70% to 85% most preferably.

[0030]As one embodiment which minimizes solid capacity occupied by wicking structure, About wicking structure capacity, by a center portion of a wicking structure. [whether there is any wicking material and] By or a method referred to as being because it being because a wicking structure only with the minimum quantity being built or a center portion of a wicking structure being pierced. It extends in a cavity periphery in a container, and is minimized by considering it as a wicking structure which does not have a wicking structure in a cavity center portion substantially. No liquid fuel in a cavity is based on direction, but maintains an exit passage and fluid contact of a container by capillary action at least with a wicking structure which occupies a cavity periphery at least. By reducing quantity of wicking material of a wicking structure center section even to the minimum, wicking structure capacity is minimized and can maximize quantity of liquid fuel which can accommodate a fuel reservoir as a result. if for example, a cavity in a container has eight corners in shape of a square or a rectangle and is flat -- a wicking structure -- at least eight corners of a cavity -- or it is arranged very near it. If a cavity is flat, in shape of a square or a rectangle a wicking structure, Whole shape of a form

like a rim of whole shape which is a sheet with two or more punched holes of a square or a rectangle, a square, or a rectangle or an alphabetical letter "E", "H", "K", "M", "N", "X", or "Z" can be taken. On the other hand, if a cavity in a container is flat at a round shape or an ellipse form, a wicking structure will be arranged as a ring of circular or an ellipse form along with an end at which a cavity turned at least.

[0031]The container of a fuel reservoir can take shape whose sizes and shape are various, such as shape of an almost cylindrical cartridge similar to a disposable dry cell, or other known cell cartridges. As an exception method, especially preferably, a container is almost flat, and is thin, and it is a form of a pouch, a packet, or an envelope where it has the flexible upper surface and the bottom. can form an envelope from a sheet of a flexible plastic film of one sheet or two or more sheets, or a plastic coated film, and a side face end part of a sheet doubles it -- heat sealing -- or ultrasonic welding is carried out. When filled with liquid fuel, such an envelope container can be bent flexibly, this fluid is held, it can measuring-supply or the wicking structure which has there at least a part of wicking of liquid fuel can send this fluid, even if a container is bent severely. Since an exit passage is covered when being conveyed or kept before an envelope container's using it, a tape which can be removed may be attached.

[0032]A fluid liquid-sending means, for example, a pump, or Wick is usually open for free passage with an exit passage of a fuel reservoir, in order to send liquid fuel through an exit passage from a container. As an exception method, the liquid fuel can flow out of a container through an exit passage with gravity. gravity -- or by operation of a fluid liquid-sending means, liquid fuel which leaves a container can be preferably sent to an anode of a liquid fuel cell. In one embodiment, liquid fuel can be sent to an anode using Wick whose Wick capillary action is larger in an immediately near portion to an anode than in a portion very near the exit passage and which has a difference in capillary action. Liquid fuel can also be sent to an anode by a series of Wick which capillary action differs, is combined mutually and produces inclination in capillary action in option in order to turn a flow of liquid fuel to an anode from an exit passage. When a container is built with a hard material and liquid fuel goes away from a container through an exit passage, a container is equipped with an air inlet with an one way valve so that gas can flow into container capacity. An air inlet is option, when a container is built with a flexible material, for example a container is a flexible pouch.

[0033]Further embodiment of this invention is the wicking material for a fuel reservoir for liquid fuel cells formed by a wicking structure which consists of foam, a fiber bundle, or non-woven textile. Preferably, a wicking structure is polyurethane foam (preferably). Felt-like polyurethane foam, mesh shape polyurethane foam, or felt-like mesh shape polyurethane foam, It is built with wicking material chosen from nonwoven felt or a bunch of polyester, such as polyamide, such as melamine foam and nylon, polypropylene, and polyethylene terephthalate, cellulose, polyethylene, polyacrylonitrile, and these mixtures. A wicking structure built with such a wicking

material makes it possible to be measuring-supplied or to send wicking of a fluid, and not only maintenance but a fluid by a controllable method, from such a structure. Free rise Wick height (measure of capillary action) of a wicking structure is larger than 1/at least 2 of the longest size preferably. Free rise Wick height is larger than the longest size most preferably.

[0034]In a desirable embodiment, wicking material has especially the inclination of capillary action that it has a difference in capillary action between two portions, and as a result a flow of liquid fuel is oriented with another portion of material from some materials. Wicking material can be formed as a complex of a structure with same or different material separate as an exception method that has a difference in capillary action clearly.

[0035]When polyurethane foam is chosen as a wicking material, density of this foam is in the range of 0.5 to 25 pounds per cubic foot, The pore size should be in the range of 10 to 200 pores / inch, Density of pore size is the range of 40 to 200 pores / inch in the range of 0.5 to 15 pounds per cubic foot preferably, and density of pore size is the range of 75 to 200 pores / inch in the range of 0.5 to ten pounds per cubic foot most preferably.

[0036]When felt-like polyurethane foam, such as felt-like mesh shape polyurethane foam, is chosen as a wicking material, Density of this foam is in the range of two to 45 pounds per cubic foot, The compression ratio should be in the range of 1.1 to 30, range of a compression ratio of density is 1.1 to 20 in the range of three to 15 pounds per cubic foot preferably, and range of a compression ratio of density is 2.0 to 15 in the range of 3 to 10 pounds / cube Fet most preferably.

[0037]The fuel reservoir of this invention can hold liquid fuel for fuel cells indirectly or directly. An example of liquid fuel which a fuel reservoir can accommodate in direct fuel cells is methanol, ethanol, ethylene glycol, dimethoxymethane, trimethoxy methane, formic acid, or hydrazine. Liquid hydrocarbon, for example, methanol, petroleum, and diesel fuel are included in liquid fuel which a fuel reservoir can accommodate in an indirect fuel cell or reformers. A fuel reservoir of this invention contains methanol preferably as liquid fuel. Methanol in a fuel reservoir is an aqosity mixture of methanol, or desirable pure methanol. Concentration of methanol in an aqosity mixture expresses concentration percentage of methanol with weight to weight, At least about 5% at least about 3% preferably At least about 25%, more -- much more -- desirable -- at least about 50% -- further -- more -- much more -- desirable -- at least about 60% -- and it is about 70% to about 99%, for example, about 85%, 90%, 95%, or 99% most preferably.

[0038]

[Embodiment of the Invention]If drawing 4 is referred to from drawing 2, the cartridge containers 20 will define the cavity which accommodates the liquid fuel mixture 22. The outlet tubes 24 pierce through the covering 28, and are prolonged in the container 20, and the outlet tubes 24 open between the cavity of the container 20, and the container exteriors for free

passage. The air inlet tube 26 also pierces through the covering 28, and is prolonged in the container 20. In order to prevent a fluid flowing out of the container 20, the one way valve (not shown) may be contained in the air inlet tube 26.

[0039]It has the wicking structure 32 in the cab tee of the container 20. The wicking structure 32 encloses the open end part of the outlet tubes 24 in the cavity of the container 20. Liquid fuel makes wicking a wicking structure.

[0040]In the embodiment shown in drawing 4 from drawing 2, a wicking structure is the felt-like polyurethane foam formed by the rectangle square shape or the core box. For example, this structure is 10mm(width) x5mm(thickness) x90mm (height) mostly considering a height of 90 mm as the longest size of a structure.

[0041]Foam was manufactured using the following mixtures.

[0042]

Arcol 3020 Polyol (Bayer.) Corp.100 copy Water 4.7 Dabco. NEM(Air Products)1.0 A-1(OSi Specialities/Crompton) 0.1 Dabco T-9(Air Products) 0.17 L-620(OSi Specialities/Crompton) 1.3

[0043]These were mixed for 60 seconds, and after neglecting it for 30 seconds and deaerating, toluene diisocyanate of 60 copies was added. Mixed this mixture for 10 seconds, and next it was made to put in and foam in the box of 15 "x15" x5", and was made to harden for 24 hours. The density of the obtained foam was 1.4 pounds per cubic foot, and pore sizes were 85 pores / inch. Foam was made into the shape of felt by applying the sufficient heat (360 Fahrenheit) and pressure for that (namely, compression ratio =5) which compresses foam into one fifth of the thickness of the origin of it. Heat and a compression pressure were applied for about 30 minutes. The density of felt-like foam was 7.0 pounds per cubic foot.

[0044]The aquosity fuel solution which contains 6 ml of methanol [95% of] in the container 20 is filled. The covering 28 of a container is provided with the Lavar Ceram stopper (rubber serum stopper) 34.

[0045]The pump 30 acts on the outlet tubes 24, and pulls out the liquid fuel 22 through the outlet tubes 24 from the wicking structure 32. Only making few vacuums act on the outlet tubes 24 is needed for pulling out a fuel mixture from a container. It cannot be based on direction of a container but fuel can also be pulled out. By one examination, the pump was fixed and installed using the container in direction of "it is perpendicular" as shown in drawing 4 from drawing 2, and 5.0-ml liquid fuel was pulled out from the fuel reservoir. By the 2nd examination, direction pulled out the liquid fuel which exceeds 2.0 ml from a fuel reservoir by setting out of the same pump using the container (not shown) of an "up-and-down contrary." By direction of an "up-and-down contrary", although liquid sending of fuel became less efficient, liquid sending of fuel was not barred like [in the case of other fuel reservoirs].

[0046]In another embodiment (not shown), the wicking structure which is the polyester non-woven textile pad mostly formed by a rectangle square shape or a core box of

10mmx5mmx90mm was chosen. The non-woven textile pad set the bulk fiber (sheath-ized polyester in which the coat of polyester and the melt binder was carried out), was mixed, and was manufactured by forming a mixture in a layer with a calmed roller (combed roller). This layer was removed from the roller with the comb which is moving, and it moved to the conveyor belt. The conveyor belt supplied material to the articulated arm (articulated arm) which accumulates two or more layers on another conveyor belt. Heating compression of two or more layers was carried out at the last thickness of the wish. Liquid sending of the same fuel was checked by this polyester non-woven textile wicking structure.

[0047]In another embodiment (not shown), the wicking structure contained needle felt. The blend of polyester and polypropylene which were recycled, and a nylon fiber was opened, and the comb roller pulled out the fiber layer. This layer was removed from the roller with the comb which is moving, and it moved to the conveyor belt. The conveyor belt supplied this material to the articulated arm which accumulates two or more layers on another conveyor belt. It let two needling work which the arrangement of the needle which has starting [supply] in two or more layers (it has a doubled thickness of about 10 inches) doubles two or more layers, and does compact pass. the textiles of a certain quantity should pierce through a sample again, and needling should be pulled forcibly, and should be involved -- ***** -- it is made like and the final shape of needle felt is maintained to one. The same fuel liquid sending was checked using the wicking structure formed as needle felt of a rectangle square shape.

[0048]Next, reference of drawing 5 and drawing 6 shows another container which consists of a flexible package for fuel reservoirs. A fuel liquid-sending flexible pouch, a packet, or the envelope 40 is provided with the sheet of one sheet or two or more sheets which forms the pouch, packet, or envelope which is combined together and has the seal end 42. Preferably, a sheet is combined by heat sealing or ultrasonic welding. The envelope 40 defines the central capacity which forms the reservoir for the liquid fuel 52 for fuel cells. The air inlet 44 is provided with the one way valve 46 in order to prevent liquid fuel flowing out of the envelope 40. The air inlet 44 provides the passage where air enters there, when liquid fuel is pulled out from envelope capacity.

[0049]The outlet tubes 48 pierce through the envelope 40, and it has them. Outlet tubes carry out fluid contact of between the interior volume of an envelope, and fuel cells. Before use, the outlet tubes 48 are usually covered with the cover tape 50, and this is shown by the border line of the phantom drawing technique by drawing 5. This tape covers the opening of the outlet tubes 48. Thus, without liquid fuel leaking from there, it can convey and the fuel reservoir with which it was filled up beforehand can be kept. The tape 50 is removed when being attached, since it is used for an envelope supplying fuel to a fuel cell.

[0050]The wicking structure 54 is formed with the material described above in relation to the embodiment of drawing 4 from drawing 2, and is held in the capacity of the envelope 40. A

pump (not shown by drawing 5 and 6) is used for pulling out liquid fuel through the outlet tubes 48 from the interior volume of a reservoir like a 1st embodiment. According to this embodiment, liquid sending of efficient fuel is carried out regardless of direction and wicking structure of an envelope like a 1st embodiment.

[0051] Preferably, the size of the wicking structure 54 corresponds with the interior volume of the envelope 40. Since the wicking structure 54 is preferably formed with a flexible film material, when using it, the envelope 40 can bend all the fuel cell liquid-sending systems so that various positions and shape may be suited, and it can make it meet flexibly [it is desirable and]. The envelope 40 of this desirable embodiment is lightweight, and is substantially formed with the flat upper part or bottom.

[0052] Reference of drawing 7 and drawing 8 shows another flexible fuel reservoir. The fuel reservoir by drawing 7 and drawing 8 is the same as that of drawing 5 and the flexible fuel reservoir of drawing 6 except there not being the air inlet 44 and the one way valve 46 so that a flexible pouch may be crushed, when fuel is pulled out.

[0053] Drawing 9 and drawing 10 show another flexible fuel reservoir of this invention. Drawing 9 and the flexible fuel reservoir of drawing 10 are the same as that of the flexible fuel reservoir by drawing 7 and drawing 8 except the liquid fuel entrance 56 with the valve 58 for introducing liquid fuel into a flexible pouch, in order to re-fill up a flexible fuel reservoir with liquid fuel and to make a fuel reservoir recyclable existing.

[0054] Drawing 11 and drawing 12 show the flexible fuel reservoir in which another recycling of this invention is possible. After some of original liquid fuel or all are taken out from a reservoir, in order that drawing 11 and the fuel reservoir of drawing 12 may re-fill up the used fuel reservoir with liquid fuel and may make a fuel reservoir recyclable, The liquid fuel entrance 57 by which is a thing similar to an injector or this, and the seal was carried out by the desirable film 59 made from rubber for introducing new liquid fuel into a flexible pouch exists. Except this, it is the same as that of the fuel reservoir by drawing 9 and drawing 10. In this embodiment, by piercing an injector etc., liquid fuel can be introduced into a cavity through this film, and a film carries out re-sealing of the cavity after liquid fuel introduction.

[0055] How many Embodiments 100, 102, 104, 106, 108, 110, 112, and 114 of the fuel reservoir by which the capacity of the wicking structures 73, 74, 75, 77, 79, 81, 83, and 85 was minimized are shown in drawing 20 from drawing 13. Each fuel reservoir is provided with the container 72 which defines the cavity 76, and has the wicking structures 73, 74, 75, 77, 79, 81, and 83 or 85, the liquid fuel exit passage 78, and the air inlet 80 (the container 72 is because it is built with a hard material) of option. Even if the wicking structures 73, 74, 75, 77, 79, 81, 83, and 85 of these fuel reservoirs have few cavities 76, they occupy a periphery. The wicking structure can have the shape of the form of the shape (see drawing 14) of the shape (see drawing 13), square, or rectangle which has three sides or an alphabetical letter "H", "X", "N",

"M", "K", or "E" (see drawing 15 - 20, respectively).

[0056]Drawing 21 shows roughly the embodiment of the recyclable fuel reservoir by this invention. The recyclable fuel reservoir 116 is provided with the liquid fuel exit 78 which has the desirable film 84 made from rubber on the container 72, the wicking structure 73, the cavity 76, the air inlet 80 of option, the seal cap 82, and a seal cap. After some of original liquid fuel or all were taken out from the fuel reservoir in this embodiment, A fuel reservoir can be separated from a fuel cell, and then the seal of the opening of the liquid fuel exit 78 is carried out by the seal cap 82, and new liquid fuel is poured in through the film 84, and a spent fuel reservoir can be re-filled up with liquid fuel.

[0057]Drawing 22 is a schematic diagram of another embodiment of the recyclable fuel reservoir by this invention. The recyclable fuel reservoir 118 is provided with the liquid fuel exit 88 where the container 72, the wicking structure 73, the cavity 76, the air inlet 80 of option, and the valve 86 were attached. After some of original liquid fuel or all are taken out from a fuel reservoir, the valve 86 can be shut and a fuel reservoir can be separated from a fuel cell. a fuel reservoir -- recycling -- in order to enable [possible or] re-restoration, new liquid fuel can be introduced into a spent fuel reservoir through the valve 86, and a spent fuel reservoir can be re-filled up with liquid fuel.

[0058]Drawing 23 outlines the embodiment which the exchangeable fuel reservoir 200 of this invention has combined with the anode 212 of the fuel cell 210 through fuel liquid-sending Wick 208. The exchangeable fuel reservoir 200 is provided with the container 204 which defines the cavity 206 containing the wicking structure 202. The wicking structure 202 of the fuel reservoir 200 touches fuel liquid-sending Wick 208. The capillary action of fuel liquid-sending Wick 208 is larger than the capillary action of the wicking structure 202, and the inclination of capillary action is made and it sends liquid fuel to the anode 212 of the fuel cell 210 from the fuel reservoir 200.

[0059]Especially, in a desirable embodiment, the wicking structure is built with foam with the inclination of capillary action, and the flow of liquid fuel is oriented with another portion of a structure from a part of structure as a result of the difference in the capillary action between two portions. One method of manufacturing material with the inclination of capillary action is changing a degree of compaction along with the longitudinal direction, and making foam into the shape of felt. The option which manufactures material with the inclination of capillary action is assembly-izing the complex of an individual ingredient with the capillary action which is different clearly. The flow by the capillary action of a fluid goes to the large portion of capillary action relatively from the small portion of capillary action.

[0060]Drawing 24 and drawing 25 show roughly how to build wicking material with the foam etc. which have inclination in capillary action. As shown in drawing 24, it has the 1st thickness T1 at the 1st end 61, and, as for the wedge shape slab 60 which consists of foam of uniform

density and pore size, it has the 2nd thickness T2 at the 2nd end 65. The slab 60 follows a felting step with it being desirable for carrying out time hot pressing and compressing into fixed thickness T3 smaller than the thickness T1 and T2. The big compressive force expressed by the arrow 62 is needed for compressing material into T3 by 61 from the 1st end T1 more relatively than the compressive force which is needed for compressing material into T3 from the 2nd end 65T2 and which is expressed with the arrow 64.

[0061] Along with the longitudinal direction of the felted foam which is shown in drawing 25, the compression ratio of a foaming material is changing and serves as the compression greatest at the 1st end 61A (from T1 to T3) as compared with the 2nd end 65A (from T2 to T3). Capillarity pressure is inversely proportional to an effective radius of capillary, and an execution radius of capillary will decrease, if stiffness, i.e., compression, increases. The arrow 66 of drawing 25 expresses the flow direction according [the stiffness or capillary action of a small portion to felt] to the capillary action to a large portion relatively in the stiffness or capillary action of felt. Thus, when wicking material or a wicking structure is formed with material or a composite material with the inclination which is capillary action, The liquid fuel sucked up by material can be oriented so that it may flow into another large portion relatively [a compression ratio] from some small materials relatively [a compression ratio].

[0062] This invention was shown by detailed explanation and example of the desirable embodiment. A gestalt and various change which can be set in detail are in the skill of the engineer of a field for the time being. Therefore, this invention must be estimated by the claim and does not become depending on explanation of an example or a desirable embodiment.

[Translation done.]

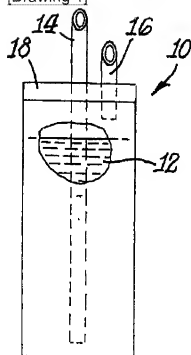
* NOTICES *

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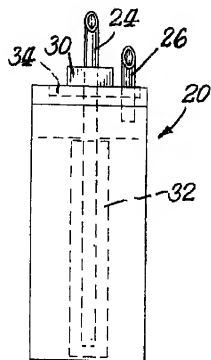
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

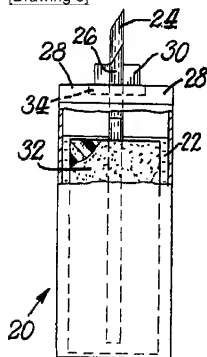
[Drawing 1]



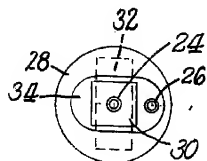
[Drawing 2]



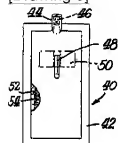
[Drawing 3]



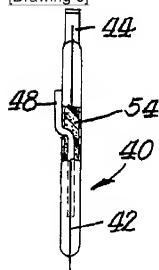
[Drawing 4]



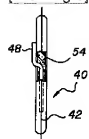
[Drawing 5]



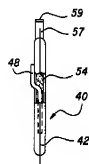
[Drawing 6]



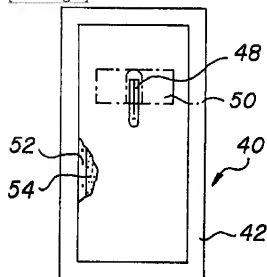
[Drawing 8]



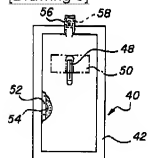
[Drawing 12]



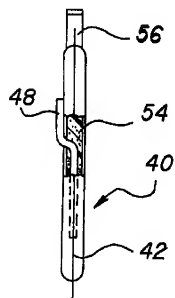
[Drawing 7]



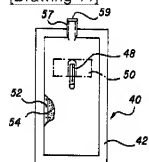
[Drawing 9]



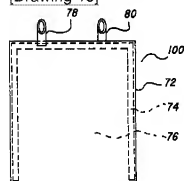
[Drawing 10]



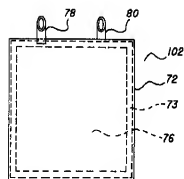
[Drawing 11]



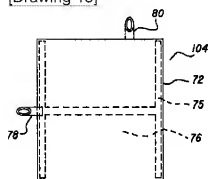
[Drawing 13]



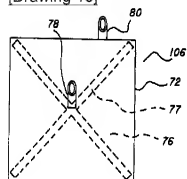
[Drawing 14]



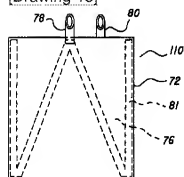
[Drawing 15]



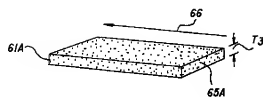
[Drawing 16]



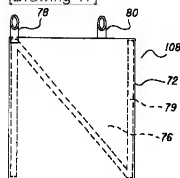
[Drawing 18]



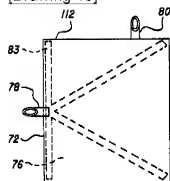
[Drawing 25]



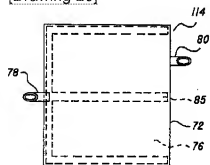
[Drawing 17]



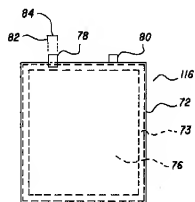
[Drawing 19]



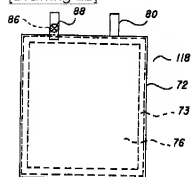
[Drawing 20]



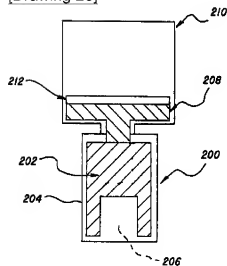
[Drawing 21]



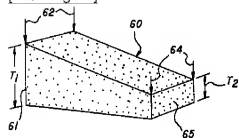
[Drawing 22]



[Drawing 23]



[Drawing 24]



[Translation done.]